A Marshall Cavendish Collection

EVERY FORTNIGHT

QUEST

ADVENTURES IN THE WORLD OF SCIENCE

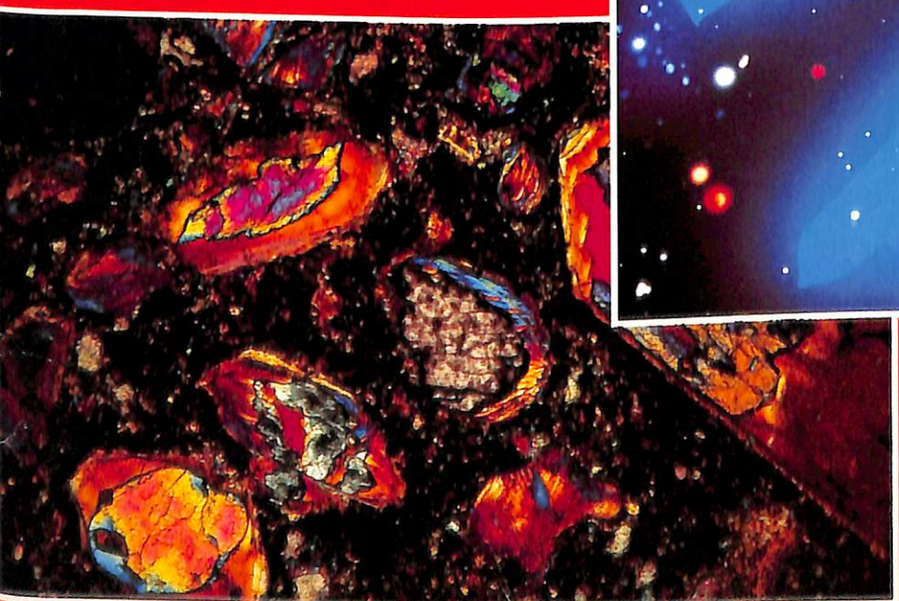
TIME

19

FACT FILES ON:

- Time travel
- Atomic clocks
- Carbon dating
- The beginning of time
- Lunar cycles
- Time-lapse photography
- Lifespans

GIANT POSTER



THREE PROJECTS

MAKE A SUNDIAL

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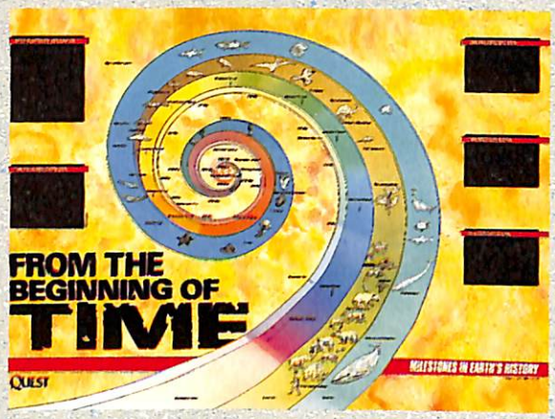
INSIDE THIS PACK

FACT FILES

▶ Zero time ▶ Black holes ▶ Clues from fossils ▶ Biological clocks ▶ Life expectancy ▶ Measuring time ▶ High speed cameras



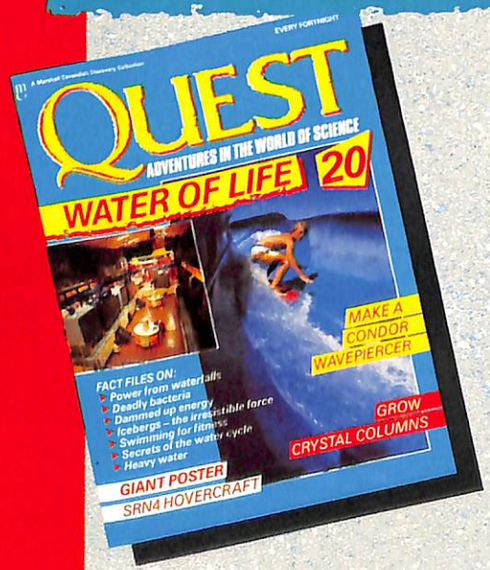
POSTER

Earth from the beginning of time

PROJECT SHEET

- Find South with a watch
- Track the moon
- Measure time with a pendulum

COMING IN QUEST 20 WATER OF LIFE



FACT FILES INCLUDE:

▶ Water power
▶ Hydrotherapy
▶ Acid rain
▶ Desalination
▶ Heavy water
▶ Evaporation and precipitation

POSTER

Hovercraft

MODEL

Wavepiercer

ISSN 1350-3766

THE HISTORY OF THE EARTH

The Earth was born, together with the other planets of the solar system, about 4,600 million years ago, according to astronomers. The oldest rocks known are about 4,000 million years old, and they mark the start of the geological record. Geologists divide the history of the Earth into four major divisions, called eras, and each of these into periods, on the basis of geological events such as major upheavals of the land. The most recent periods are further divided into 'epochs'. Valuable clues to the ages of rocks are furnished by the fossils – traces of ancient life – that they contain, but they can be dated most accurately by measurements of their radioactivity. The sequence of geological eras, periods and epochs is shown here with a sample of just a few of the millions of plants and animals that have flourished on the Earth since Time began.

THE PRECAMBRIAN ERA

The Earth was born from the cloud of dust and gas that surrounded the newly born Sun. Grains of dust gathered together under their own gravity and were compressed into rock by their own weight. The new planet was heated by radioactivity in the rocks and by intense meteoric bombardment. Iron gathered at the planet's centre to form a hot, dense core. The oceans and the atmosphere, which did not yet contain oxygen, were born from gases given out from within the Earth. The first simple organisms developed in the seas, with soft bodies that rarely left fossil traces.

John Haughton

My = million years

Permian Period

Winged insects

250 My

Carboniferous Period

275 My

1000 My

AGE OF FISH

Amphibians

350 My

Bony fish

Devonian Period

Precambrian Era

3000 My

Beginning of life?

1500 My

4600 My

3500 My

Photosynthesis

First insects

Formation of the Earth

400 My

2500 My

4000 My

570 My

Silurian Period

420 My

2000 My

Palaeozoic Era

Ordovician Period

490 My

Cambrian Period

Jawless fish

Corals

FROM THE BEGINNING OF TIME

QUEST

ERAS

GEOLOGICAL TIME

LAND

THE PALAEOZOIC ERA

With the development of organisms with hard bodies, there is an explosion of fossils in the rocks, marking the advent of the Palaeozoic ('ancient life') era. Corals, sponges, and molluscs evolved. Animals with backbones, including fish, appeared. Life spread on to the land. Plants transformed the face of the Earth by producing the oxygen that makes our atmosphere unique. Great forests appeared, of which modern coal seams are the remains. Winged insects developed and reptiles spread.

THE MESOZOIC ERA

Rocks that today form large parts of mountain ranges such as the Alps and Himalayas were being laid down on ocean beds around the globe. On land and in the sea the reptiles developed ever more specialized and successful forms, including the dinosaurs. Some even took to the air. The first small mammals, and the first birds, developed from the reptiles. The flowering plants appeared. The dinosaurs became extinct at the end of the era.

THE CENOZOIC ERA

This is the age of the mammals. They diversified into countless types, including large browsing animals, such as cattle, and carnivores, such as the big cats. Some returned to the sea, evolving into whales and dolphins. The primates developed from small insect-eating mammals, and gave rise to human beings. Sabre-toothed cats, woolly rhinos, mammoths and other large mammals appeared and then became extinct. In the plant kingdom, grasses, cereals and fruits gradually developed.

MILESTONES IN EARTH'S HISTORY

Sponges

rd-bodied creatures

185 My

140 My

65 My

Mesozoic Era

Cenozoic Era

Triassic Period

Jurassic Period

Cretaceous Period

Tertiary Period

Quaternary Period

First birds

AGE OF REPTILES

Dinosaurs flourished

First mammals

Flowering plants

Primates

Grasses

First whales

AGE OF MAMMALS

Whales and dolphins

First human beings

LIFE

SEA LIFE

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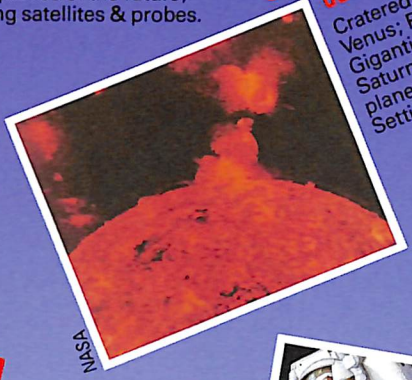
The launch procedure; Space junk – a growing hazard; The Soviet Shuttle; Ariane; Spaceplanes of the future; Tracking satellites & probes.


NASA

2. THE SOLAR SYSTEM – our space neighbours

Cratered Mercury; Clouds of Venus; Red sands of Mars; Gigantic Jupiter; Ringed Saturn; Remote outer planets; Sampling a comet; Setting foot on Mars.


NASA

4. TO THE MOON – "A giant leap for mankind"

Driving on the surface; Rock collecting; Our neighbour world; How the Moon affects Earth; What we learned from Apollo; What to see on the Moon.


Marshall Cavendish

3. FLYING IN SPACE – the astronauts

Astronaut training; Weightlessness; A trip on the Shuttle; Working in Space; Living on the Shuttle; The spacesuit; Walking in Space; Human satellites.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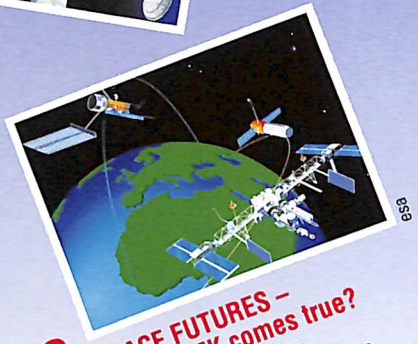
5. USING SPACE – a practical dimension

How satellites work; Tuning into Space; Earth watch from orbit; Improving weather forecasts; Spies in Space.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6. SPACE FUTURES – STAR TREK comes true?

Soviet house in orbit; Weightless processing – the new industrial revolution? Cities in the sky; Return to the Moon; Freedom beckons ...

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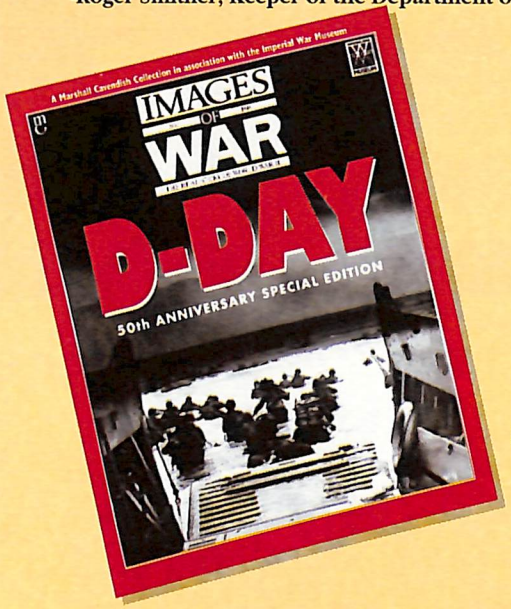

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MODEL ASSEMBLY INSTRUCTIONS

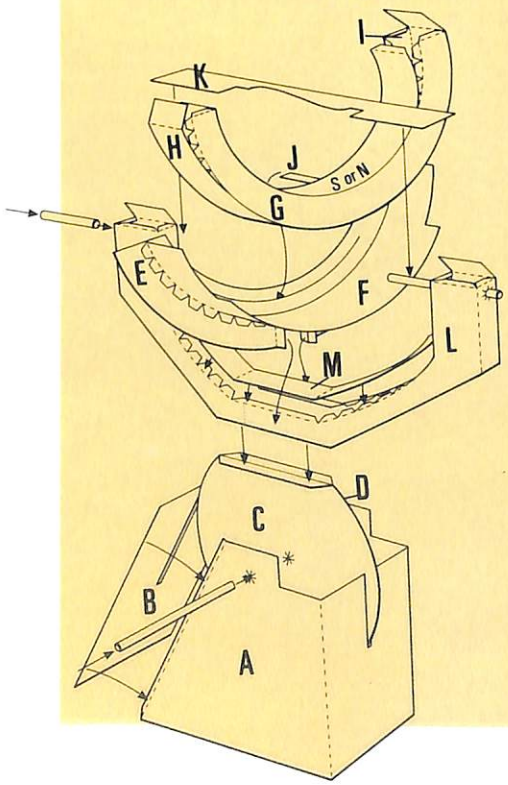
SUNDIAL

You will need
Scissors · Ruler · Craft knife · Glue · Drinking straws, 3–4mm across.

Before cutting out the pieces, score along all broken lines with a blunt edge and ruler to make folding and gluing easier. Study the ASSEMBLY DIAGRAM to see how the pieces fit together, and use dotted lines as a guide for positioning.
NB Younger children will need supervision when using a craft knife.

To make up
Stand and latitude circle
1 Cut out stand **A**. Cut slot using a craft knife and make small slits at star shapes. Fold and glue to shape (see ASSEMBLY DIAGRAM).
2 Cut out stand front **B**. Cut slot using a craft knife and glue in position on front of **A** to complete stand.
3 Cut out latitude circle back **C** and front **D**, and make small slits at star shapes. Fold tabs out and glue back to back.

Platform
1 Cut out platform **E**. Fold tabs up. Fold in half along dotted lines and glue to shape (see ASSEMBLY DIAGRAM), putting no glue on tabs. Using a craft knife, cut curved slit through both pieces of card.
2 Cut out adjustment scale **F**. Fold tabs back and glue to **E** along dotted line, so that scale faces inwards. Align markers.



Hour circle and scale
1 Cut out hour circle top **G**. Fold tabs down.
2 Cut out hour circle back **H** and glue to tabs around outside edge of top **G**, leaving tab free at either end.
3 Cut out hour circle bottom **I** Fold tabs up and glue to inside edge of back.
4 Cut out hour scale (if you live in the northern hemisphere – north of the equator – use **N**, if you live in the southern hemisphere use **S**). Glue to inside of hour circle, remembering that the top of the hour circle has a marker line. Fold over and glue end tabs.
5 Cut out adjuster tab **J**, fold and glue lengthways in position marked on bottom of hour circle see (ASSEMBLY DIAGRAM).
6 Cut out gnomon **K** as a rectangle, apply glue and fold in half. Then cut out shaped area, cutting through both pieces of card.

Yoke
1 Cut out yoke **L**, make small slits at star shapes, and make up (see ASSEMBLY DIAGRAM). Stick yoke front **M** in position.

To assemble
1 Place latitude circle in slits in base so that scale may be read against arrow mark at back of stand. Pass a straw through slits in stand and latitude circle, so latitude circle can revolve.
2 Glue platform **E** to inside of yoke **L** with scale upwards at position marked by dotted lines on yoke.
3 Glue back of yoke to tabs on latitude circle, with 90° nearest 'top' label.
4 Slide adjuster tab on hour scale through slit in platform. Hour scale should sit snugly on platform.
5 Cut two 50mm pieces of straw and push through upper and lower ends of yoke. Glue gnomon to projecting ends of straws (see ASSEMBLY DIAGRAM) with **'N'** and **'S'** marks on outside. If you live in the northern hemisphere **'N'** on gnomon should be uppermost. If you live in the southern hemisphere, **'S'** should be uppermost.

NB For extra stability, place a stone in the bottom of the stand.

How to use your sundial
Choose a sunny location for your sundial. From this spot, find out where north or south is – a large-scale map of your area should help (a compass points magnetic north not true north).

Align the sundial with the longest edge of the stand north-south, so that the shadow of the gnomon falls on the hour scale. Find your geographical line of latitude from an atlas and set the latitude scale accordingly against the arrow on the stand.

Finally, turn the gnomon so that the appropriate side for the time of year is face on to the sun. Note where the shadow of the curved edge of the gnomon crosses the line on the hour scale, and adjust the hour scale to read the exact time.

The dial should keep accurate time throughout the year, though you will have to adjust it for summer time.

PROJECTS

TIME

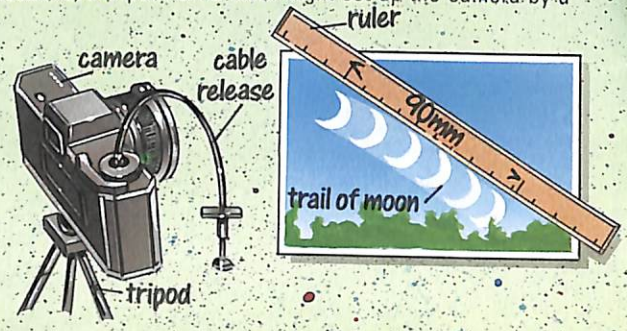
- 'Freeze' a period of time using photography
- Find the points of the compass with a watch
- How can you measure time with a pendulum?

CAPTURING TIME

1 2 3 **4** 5

Using the technique of time-exposure photography, you can trace the orbit of the Moon over a period of time.

You need a camera with a manual shutter control that has a position B, a cable release that can be locked and, if possible, a tripod. On a clear night set up the camera by a window. Point the camera at the sky with the Moon at the base of the viewfinder. Set the shutter on B. Press the cable release to open the shutter, then lock it. After half an hour, unlock the cable release to let the shutter close. When you get the picture printed you will see that the Moon has left a clear, white trail in the sky.



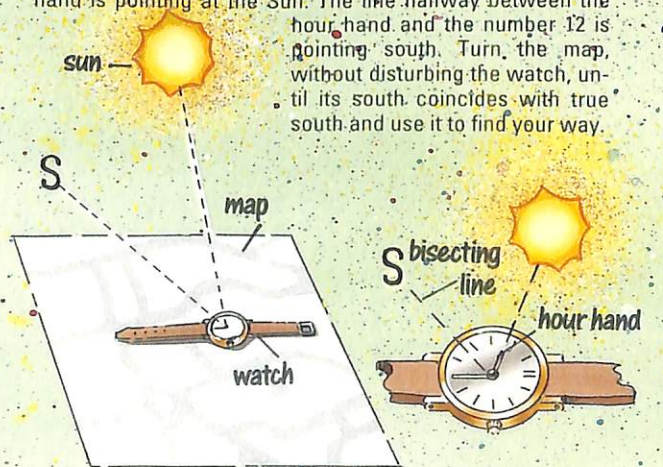
moon travels 15° per hour 60/15=4min per °
if moon travels 90mm in 1/2 hour it
travels 90/7·5=12mm every 4 min

FINDING SOUTH

1 2 3 4 5

Finding out your direction from the Sun is not difficult. All you need is a watch.

At 12 noon the Sun stands exactly in the south so it is very easy to find south, north and other points of the compass. To find south at other times of the day take a map of the area and lay a watch on top of it. Turn the watch until the hour hand is pointing at the Sun. The line halfway between the hour hand and the number 12 is pointing south. Turn the map, without disturbing the watch, until its south coincides with true south and use it to find your way.

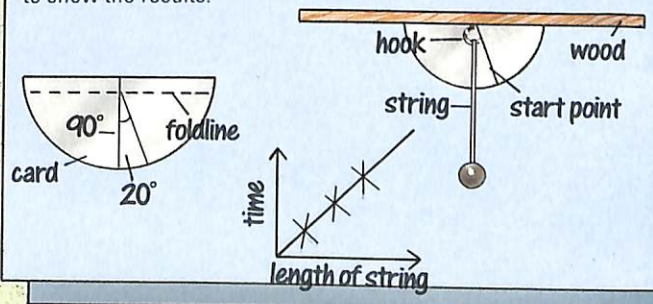


PENDULUM

1 2 3 **4** 5

The pendulum, the basis of clocks for centuries, is one of the most reliable timekeeping devices.

Make a swing gauge as shown and secure it to the pendulum. Release the pendulum at the start line and time 20 swings for a pendulum 50cm, 75cm and 100cm long. Divide by 20 to get the 'periods' of the pendulums then plot a graph to show the results.



PROJECT INFORMATION

1 2 **3** 4 5

*Each **QUEST** project has its own difficulty rating: 1 very simple, 2 simple, 3 intermediate, 4 advanced, 5 complicated.*

WARNING!

Parents should ensure that experiments involving sharp tools, water and electricity are supervised. The publisher can accept no responsibility for injury.

SUNDIAL

H

S

Read time where curved shadow crosses line.

N

Read time where curved shadow crosses line.

F

C

D

Latitude

A

M

K

Point this face towards sun Dec 22 ~ Jan 21

Point this face towards sun Jan 21 ~ Dec 21

N

S

E

B

L

top

G

I

J